

CLAIMS

Sub A1
 1. A device for the trenchless replacement of in-situ pipe, comprising:
 a mole;
 a length of cable, said cable being engagable to said mole;
 a cable pulling means including a cable pulling device and a cable pulling device engagement means functioning to provide a mounting structure for said cable pulling device.

Sub B1
 2. A device as described in claim 1 wherein said cable pulling device includes a cable engagement mechanism that functions to pull said cable in a plurality of repeated cyclic pulling strokes.

3. A device as described in claim 1 wherein said cable engagement mechanism functions to engage said cable in a pulling stroke, release said cable in a recovery stroke, and engage said cable in a further pulling stroke, whereby said cable pulling device conducts a repeatable cycle of pulling and releasing of said cable.

4. A device as described in claim 3 wherein said cable pulling device includes at least one cable engaging collet that functions to engage said cable on a said pulling stroke and to release said cable on a said recovery stroke.

5. A device as described in claim 4 wherein at least one further collet is provided that functions to engage said cable on said recovery stroke and release said cable on said pulling stroke.

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 6. A device as described in claim 5 wherein said further collet is engaged within said cable pulling device.

7. A device as described in claim 2 wherein said cable pulling device is formed with a slotted cable insertion means for the sideways insertion of said cable within said cable pulling device.

1 ~~8.~~ A device as described in claim 1 wherein said cable pulling device is a post tensioning
2 ram (PTR).

1 ~~9~~ ⁹ ~~10.~~ A device as described in claim 8 wherein said pipe is composed of a malleable material
2 or a fracturable material.

1 ~~11.~~ ¹⁰ A device as described in claim 8 wherein said cable pulling device is used to generate a
2 pulling force up to and over 100 tons (200,000 pounds), for distances of from 2 feet to over one
3 mile; said pulling forces not being affected by cable length.

1 ~~12.~~ A device as described in claim 8 wherein the PTR is relatively light-weight and portable
2 as a result of using high pressure hydraulics in small hydraulic cylinders.

1 ~~13.~~ A device as described in claim 8 where the weight to pulling force ratio of the PTR is in
2 the range of 2 pounds of weight per ton (2,000 pounds) of pulling force.

1 ~~14.~~ ¹³ A device as in claim ~~12~~ ¹¹ wherein high pressure hydraulics (5,500 to 20,000 PSIG) are
2 used to give the PTR the intense pulling power it delivers.

1 ~~15.~~ ¹⁴ A device as described in claim 1 wherein said cable pulling device engagement means
2 includes an annulus member including a cable passage bore formed therethrough and a cable
3 insertion slot formed through portions of said annulus member for the sideways insertion of said
4 cable within said cable passage bore of said annulus member.

1 ~~16.~~ ¹⁵ A device as described in claim ~~15~~ ¹⁴ wherein said annulus member includes a cable pulling
2 device holding means for releasably holding a portion of said cable pulling device therewithin.

1 ~~17.~~ ¹⁶ A device as described in claim 1 wherein said cable pulling device engagement means
2 includes a reaction plate having an enlarged surface for disbursing a reaction force against a
3 cable pulling force generated by said cable pulling device.

1 ~~18.~~ ¹⁷ A device as described in claim ~~17~~ ¹⁶ wherein said cable pulling device engagement means
2 includes an annulus member that is releasably engagable with said cable pulling device, and

- Sub A3
3 wherein said annulus member is mountable in relation to said reaction plate such that said
4 reaction plate disburses cable pulling forces exerted on said annulus by said cable pulling device.

- Sub A3 18
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2 A device as described in claim 18 wherein said annulus is formed with a cable mounting
slot, such that a side portion of said cable can be mounted into said annulus member.

- Sub A3 19
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2 A device as described in claim 1 wherein said cable pulling device engagement means
includes a cable pulling frame, said cable pulling frame being mountable to said reaction plate.

- Sub B7 20
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2 A device as described in claim 20 wherein said cable pulling frame includes a plurality of
frame members and a rotatable cable pulley being mounted to said frame members.

- Sub B3 21
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2 A device as described in claim 21 wherein said frame members are disposed to provide a
cable mounting gap that allows said frame to be mounted to a side of said cable.

- Sub B3 22
23
2 A device as described in claim 21 wherein said frame members are disposed to provide a
cable engagement path in relation to said frame, such that a side portion of said cable can be
3 mounted within said cable pulling frame and around said pulley.

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3 A device as described in claim 22 wherein said frame includes a plurality of leg members
that are engaged at an inner end thereof to a base member, and said leg members are engaged at
an outer end thereof to further frame members that engage said pulley.

- Sub B3 24
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1 A device as described in claim 21 wherein said frame members are shaped as plates.

- Sub B3 25
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2 A device as described in claim 1 wherein said mole includes a nose portion being
engagable to said cable, a tapered body portion and a replacement pipe engagement portion, said
3 mole further including at least one blade, said tapered body portion acting to expand said pipe
4 for the replacement thereof with a length of replacement pipe, and said blade acting to cut pipe
5 engagement devices encountered by said mole after said pipe has been expanded by said tapered
6 body portion.

- Sub B3 26
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1 A device for the trenchless replacement of in-situ pipe, comprising:

Sub A4
 2 ~~a mole;~~

3 ~~a length of cable, said cable being engagable to said mole;~~

4 a cable pulling means including a cable pulling device including a cable engagement
 5 mechanism and a cable pulling device engagement means functioning to provide a mounting
 6 structure for said cable pulling device;

7 said cable pulling device engagement means further including a reaction plate having an
 8 enlarged surface for disbursing a reaction force against a cable pulling force generated by said
 9 cable pulling device, and a cable pulling frame, said cable pulling frame being mountable to said
 10 reaction plate and said cable pulling device being mountable to said cable pulling frame.

Sub B9 27
 1 28. A device as described in claim 27 wherein said cable engagement mechanism functions
 2 to engage said cable in a pulling stroke, release said cable in a recovery stroke, and engage said
 3 cable in a further pulling stroke, whereby said cable pulling device conducts a repeatable pulling
 4 and releasing cycle of said cable; said cable pulling device including at least one cable engaging
 5 collet that functions to engage said cable on a said pulling stroke and to release said cable on a
 6 said recovery stroke, and wherein said cable pulling device is formed with a slotted cable
 7 insertion structure for the sideways insertion of said cable within said cable pulling device.

Sub A4 28
 2 29. A device as described in claim 28 wherein said cable pulling frame includes a plurality of
 3 frame members and a rotatable cable pulley being mounted to said frame members; and wherein
 4 said frame members are disposed to provide a cable engagement path in relation to said frame,
 5 such that said cable can be sideways mounted within said cable pulling frame and around said
 6 pulley and into said cable pulling device.

Sub A4 29
 2 30. A device as described in claim 29 wherein said mole includes a nose portion being
 3 engagable to said cable, a tapered body portion and a replacement pipe engagement portion, said
 4 mole further including at least one blade, said tapered body portion acting to expand said pipe
 5 for the replacement thereof with a length of replacement pipe, and said blade acting to cut pipe
 6 engagement devices encountered by said mole after said pipe has been expanded by said tapered
 7 body portion.

Sub A4 30
 1 31. A mole for use in the trenchless replacement of in-situ pipe, comprising, a nose portion
 2 being engagable to a cable, a tapered body portion and a replacement pipe engagement portion,

3 said mole further including at least one blade, said tapered body portion acting to expand said in-
 4 situ pipe for the replacement thereof with a length of replacement pipe, and said blade acting to
 5 cut pipe engagement devices encountered by said mole after said pipe has been expanded by said
 6 tapered body portion.

Sub B/1031
 32. A mole as described in claim ³⁰31 wherein said blade includes a relatively thin portion
 2 that is disposable within said tapered body portion of said mole and an expanded portion that
 3 projects from said tapered body portion of said mole.

Sub B/1032
 33. A mole as described in claim ³⁰31 wherein said blade is disposed within a slot formed in
 2 said mole, and wherein a rearward edge of said blade formed with an angle of approximately 80°
 3 with respect to a bottom edge of said blade, and wherein said slot is formed with a shape that
 4 corresponds to said angle, such that said blade is held within said slot.

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 34. A mole as described in claim ³⁰31 wherein a threaded bore is formed within said mole, and
 2 wherein a mole engagement fixture is fixedly engaged to an end of said cable, said fixture
 3 including a threaded end portion that is threadably engagable with said threaded bore.

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 35. A mole as described in claim ³³34 wherein said fixture further includes a hex nut portion
 2 integrally formed therewith and provided for the tightening of said threaded portion within said
 3 threaded bore.

Sub B/1035
 36. A mole as described in claim ³⁰31, further including a replacement pipe engagement sleeve
 2 member for the engagement of said replacement pipe with said mole, said sleeve member being
 3 formed with cylindrical sidewalls and an internal radially projecting wall portion having a bore
 4 formed therethrough;

5 and wherein said mole is formed with a rearwardly projecting threaded portion that
 6 projects through said bore, such that a threaded nut may be threadably engaged thereto to secure
 7 said sleeve upon said mole;

8 said sleeve further being adapted for the thermal pressure bonding of said replacement
 9 pipe thereto.

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 37. A cable pulling device engagement frame comprising:

2 ~~an annulus member including a cable passage bore formed therethrough and a cable~~
 3 ~~insertion slot formed through portions of said annulus member for the sideways insertion of a~~
 4 ~~cable within said cable passage bore of said annulus member.~~

5 ~~a reaction plate having an enlarged surface for disbursing a reaction force against a cable~~
 6 ~~pulling force generated through said annulus member.~~

1 ~~37~~ ~~38~~ A frame as described in claim ~~37~~ wherein said frame includes two cable pulling device
 2 engagement devices, such that two cable pulling devices can operationally function with said
 3 frame to pull two cables simultaneously.

1 ~~38~~ ~~39~~ A device as described in claim ~~38~~ wherein two annulus members function as said
 2 engagement devices to engage said two cable pulling devices.

1 ~~39~~ ~~40~~ A device as described in claim ~~39~~ wherein the two annulus members are angularly
 2 disposed relative to each other, such that two cable pulling devices are operationally engaged
 3 therewith.

1 ~~40~~ ~~41~~ A method for the trenchless replacement of in-situ pipe, comprising the steps of:
 2 exposing a first end of said pipe;
 3 exposing a second end of said pipe;
 4 disposing a pulling cable through said pipe between said first end and said second end;
 5 engaging a mole to said cable at said first end;
 6 engaging a cable pulling device to said cable at said second end; and
 7 installing a reaction plate at said second end, and pulling said mole through said pipe
 8 utilizing said cable pulling device.

1 ~~41~~ ~~42~~ A method as described in claim ~~41~~ wherein said second end is exposed within an
 2 excavated hole, and wherein a reaction plate is disposed against a sidewall of said hole.

1 ~~42~~ ~~43~~ A method as described in claim ~~41~~, further including the installation of a cable pulling
 2 device engagement frame between said reaction plate and said cable pulling device.

~~43~~~~42~~

- 1 ~~44.~~ A method as described in claim ~~43~~ wherein said frame includes a pulley for changing the
2 direction of said cable.

~~44~~~~41~~

- 1 ~~45.~~ A method as described in claim ~~42~~ wherein said cable pulling device is disposed within
2 ~~said hole.~~

~~45~~~~42~~

- 1 ~~46.~~ A method as described in claim ~~43~~ wherein said frame and said cable pulling device are
2 ~~disposed within said hole.~~

~~41~~

- 1 ~~47.~~ A method as described in claim ~~42~~ wherein said hole is formed of a minimal size.

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- 1 ~~48.~~ A method as described in claim ~~41~~ wherein said cable pulling device is a post tensioning
2 ~~ram (PTR).~~